Coal Combustion Residual
Landfill Closure Plan

Basin Electric Power Cooperative
Leland Olds Station

Revision 1
December 2017

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Revision History

Revision Number	Description of Revision	Reviser's Name	Revision Date
1	• Section entitled "CCR Landfill Lateral Expansion" was added to describe recent activities associated with expansion of CCR landfill footprint. • Updated "Closure Narrative" section to reflect details of landfill lateral expansion. • Updated "Final Cover System Design and Performance" section to reflect details of landfill lateral expansion. • Updated "Closure Schedule" section to reflect details of landfill lateral expansion.	Kevin L. Solie	December 5, 2017

Purpose

The purpose of this document is to demonstrate compliance with 40 CFR §257.102 (Criteria for conducting the closure or retrofit of CCR units) which requires the owner or operator of a Coal Combustion Residual (CCR) unit to prepare a written closure plan that describes the steps necessary to close the CCR unit at any point during the active life of the unit consistent with recognized and generally accepted good engineering practices.

Introduction

Leland Olds Station (LOS) is a lignite coal-fired power plant consisting of two units that generate about 669 megawatts (MW) combined. The power plant, owned and operated by Basin Electric Power Cooperative (Basin Electric), is located approximately four miles southeast of Stanton in Mercer County, North Dakota. Unit 1 went online in 1966 and Unit 2 went online in 1975. CCRs from LOS are disposed at the Glenharold Mine Landfill, regulated as special waste landfill 0143 by the North Dakota Department of Health (NDDoH).

The Glenharold Mine Landfill was first permitted for the disposal of CCRs in 1992, with disposal beginning at the facility in late 1992. The landfill is located in an upland area, approximately four miles south and west of the LOS plant site. The landfill was developed in spoils left by the surface mining of the Hagel Lignite Bed in the late 1960s and early 1970s and was constructed with a clay bottom liner. Partial sequential closure of the landfill has been conducted as areas of the landfill are filled and brought to final grade. To date, approximately 34.44 acres of the 68.09 acre original CCR landfill footprint have been closed using an engineered cover system approved by the NDDoH. A lateral expansion of the landfill consistent with the requirements of 40 CFR Part 257 (CCR Rule) was constructed in 2017 and is described below.

CCR Landfill Lateral Expansion

A lateral expansion of the CCR landfill was approved by the NDDoH and was constructed in 2017. The lateral expansion includes eight future disposal cells encompassing approximately 80.7 acres of lined landfill footprint. The design of the bottom liner, leachate collection system and final cover system for the lateral expansion meets the requirements set forth in the CCR

Rule. The expansion area is bounded by the existing landfill to the east and perimeter berms on the north, west and south sides. Ancillary features include perimeter ditches to capture runoff, three ponds to manage stormwater, a leachate evaporation pond, soil stockpiles and access roads. Each landfill cell is divided into two subcells. The initial phase of development for the expansion area (constructed in 2017) included Cell 1, which contains approximately 14.9 acres of composite landfill liner. Subsequent cells may be constructed either as subcells or as entire cells, depending on future disposal volume needs.

Since the original landfill footprint is underlain by a compacted clay bottom liner system and the lateral expansion area is underlain by a composite liner system, two distinct cover system designs are required for the facility. Both cover systems and applicable design standards are discussed below.

Closure Narrative

Areas Underlain by compacted clay bottom liner system: Once CCRs have reached final elevation in the landfill, a two-foot thick clay-rich barrier layer will be constructed over the waste to minimize infiltration potential. Clay-rich materials suitable for use as a low permeability barrier layer have been identified onsite during previous geotechnical investigations. The barrier layer would be moisture-conditioned and compacted to achieve permeabilities of 1×10^{-7} cm/second or less. Construction Quality Assurance/Quality Control (QA/QC) methodologies consistent the NDDoH guidelines would be utilized so that the final cover is constructed to meet the requirements set forth in the CCR Rule and in NDDoH rules and guidance. After the barrier layer has been constructed, an additional two feet of cover materials will be placed over filled areas. Final cover slopes of approximately 3 to 15 percent are consistent with the NDDoH rules and guidance, promoting run-off without being subject to excessive erosion.

Previous reclamation efforts at the Glenharold Mine on orphan spoils have shown that careful soil preparation and seed mix selection can be utilized to establish a diverse, effective vegetative cover despite the lack of high quality soil materials. Once the final cover material has been placed, it will be chisel-plowed to a depth of six to eight inches. Fertilizer will then be broadcast and chisel-plowed to a depth of two to three inches. Closed areas will be seeded with shallow-rooted native vegetation. After seeding has been completed, the area will be

mulched and crimped at a rate of 3 tons/acre. The closed landfill will not be used for cultivated crops, heavy grazing or any other use which might disturb the protective vegetative and soil cover.

Areas Underlain by composite bottom liner system: The construction of the final cover system will include filling and grading the waste to the appropriate final grade, placement of a buffer soil layer, construction of the composite barrier layer and placement of the rooting zone and topsoil layers. Construction of ancillary facilities such as diversion berms, ditches, piping, manholes, and any other relevant surface water management structures would also be completed. Seeding and mulching of all disturbed areas and installation of erosion control materials, such as erosion blankets and riprap would occur where necessary. Final cover slopes range from approximately 3 to 15 percent, promoting run-off without being subject to excessive erosion.

Final Cover System Design and Performance

In addition to the basic description of the final cover systems provided above, the CCR Rule requires the closure plan to address both performance and design standards for closure of the CCR unit. CCR Rule design standards require a low permeability barrier layer (infiltration layer) with a permeability less than or equal to the bottom liner system or natural subsoils present, or a permeability of no greater than 1×10^{-5} cm/sec, whichever is less. The design standards also require that the infiltration layer have a minimum thickness of 18 inches. The infiltration layer must also be overlain by an erosion layer capable of sustaining native plant growth with a minimum thickness of six inches.

Areas Underlain by compacted clay bottom liner system: The cover system will be constructed, from bottom to top, of a barrier layer consisting of a minimum of 24 inches of compacted clay-rich soil with a hydraulic conductivity of 1×10^{-7} cm/second or less overlain by a minimum of 24 inches of uncompacted material to serve as a vegetation growth medium and rooting zone. Total thickness of the cover system will be a minimum of 48 inches.

The original landfill was constructed with two-foot thick compacted soil bottom liner with a permeability no greater than 1×10^{-7} cm/sec. The permeability of the cover system barrier (infiltration layer) is no greater than 1×10^{-7} cm/sec, which is less than or equal to the low

permeability bottom liner. Accordingly, the cover system meets the design criteria for permeability.

The final cover system for the original landfill is designed with an infiltration layer thickness of 24 inches which is greater than the minimum requirement of 18 inches. The erosion layer has a minimum thickness of 24 inches, much greater than the minimum required thickness of six inches. As such, the cover system meets the minimum thickness design criteria for both the infiltration layer and for the erosion layer.

Areas Underlain by composite bottom liner system: The cover system for the lateral expansion will be constructed, from bottom to top, of a composite barrier layer consisting of an 18-inch thick layer of compacted clay-rich soil with a permeability of 1×10^{-7} cm/second or less overlain by a 40-mil linear low density polyethylene (LLDPE) textured geomembrane. The upper soil layers will include a 12-inch thick layer of subsoil, with a 6-inch thick layer of SPGM as the surface layer. The combined 18-inches of soil will support the vegetative cover. Total thickness of the composite cover system will be a minimum of 36 inches.

The lateral expansion was constructed with a two-foot thick compacted soil bottom liner with a permeability no greater than 1×10^{-7} cm/sec overlain by a 60-mil high density polyethylene (HDPE) geomembrane. For composite liners, the permeability of the geomembrane is less than the permeability of the soils liner and thus the controlling factor. The permeability of the cover system barrier (infiltration layer) is no greater than 1×10^{-7} cm/second and includes an LLDPE geomembrane. Similar to the HDPE geomembrane in the composite bottom liner, the LLDPE geomembrane is the controlling factor for permeability in the cover system. Since the cover system contains a geomembrane, the permeability of the cover system is less than or equal to the composite bottom liner. Accordingly, the composite cover system meets the design criteria for permeability.

The lateral expansion cover system is designed with an infiltration layer thickness of 18 inches which meets the minimum requirement of 18 inches. The erosion layer has a minimum thickness of 18 inches, exceeding the minimum required thickness of six inches. As such, the cover system for the lateral expansion meets the minimum thickness design criteria for both the infiltration layer and for the erosion layer.

Performance standards include ensuring the CCR unit closure system controls, minimizes or eliminates, to the maximum extent feasible, post-closure infiltration of liquids into the waste; precludes the probability of impoundment of water, sediment, or slurry; addresses slope stability; minimizes the need for further maintenance; and that closure be completed in a time consistent with recognized and generally accepted good engineering practices.

The various components of the both the original and composite cover system work synergistically to meet CCR Rule performance standards. Infiltration is minimized by using a combination of slope to promote run-off, shallow-rooted native vegetation to enhance evapotranspiration, and low permeability barrier layers to further limit infiltration. The closed landfill will be sloped to promote run-off thus limiting the probability of impounding liquids, slurry or sediment. The relatively gentle slopes (3 to 15 percent) and native vegetation on the cover system contributes to structural stability and helps minimize the need for future maintenance. The pozzolanic properties of the CCRs also promote structural stability and reduce the likelihood of settling and subsidence. The stability of the composite final cover system was analyzed as part of the NDDoH permitting process and was determined to be stable with a reasonable factor of safety. The stability analysis recommended that textured LLDPE geomembrane be used, as is included in the design approved by the NDDoH. Consistent with NDDoH rules and guidance and generally accepted good engineering practices, the cover system will be constructed in phases as areas are filled to grade (partial sequential closure).

CCR Inventory and Maximum Closure Area Estimates

The maximum inventory of CCR ever on-site (design capacity) during the active life of the CCR unit is estimated to be 13,117,000 cubic yards. The largest area of the CCR unit ever requiring final cover at any time during the CCR unit's life is estimated to be 48.55 acres, reflecting current conditions at the site.

Closure Schedule

As of November 2017, the Glenharold Mine Landfill had a remaining permitted volume of approximately 9,876,000 cubic yards, which equates to an estimated 19.75 years of remaining capacity. The lateral expansion includes eight future disposal cells, each with an average

volume of 1,170,000 cubic yards. The future disposal cells will be installed as necessary, with construction likely occurring every two to four years.

The cover system will also be constructed in several phases (partial sequential closure), with closure of areas filled to grade likely occurring every three to five years. Consistent with NDDoH rules and guidance as well as the CCR Rule, final closure will begin within thirty days after receipt of the final volume of waste and would be completed within one hundred eighty days following the onset of closure activities. Based on current projections, the landfill would be filled to capacity and final closure would occur in 2037 or 2038. The remaining life of the facility may vary depending on factors such as ash content of coal, diversion of CCRs for beneficial use, and electrical generation rates, among others.

Recordkeeping and Reporting

A copy of this document will be placed into the facility's operating record in accordance with 40 CFR §257.105 (Recordkeeping requirements) and will be posted to Basin Electric Power Cooperative's CCR Web site in accordance with 40 CFR §257.107 (Publicly accessible internet site requirements). Notification will be sent to the relevant State Director in accordance with 40 CFR §257.106 (Notification requirements).

Certification Statement

I certify that the design of the final cover system meets the requirements of 40 CFR §257.102 as specified in the *Standards for the Disposal of Coal Combustion Residuals in Landfills and Impoundments.*

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December 5, 2017